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THE FOREST SURVEY IN CALIFORNIA

By

A. E. Wieslander, Associate Silviculturist

California Forest and Range Experiment Station

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It may not be generally known that the Forest Survey in California began in 1926, fully 2 years prior to the authorization of the nation-wide forest survey by the McSweeney-McNary Research Act of 1928. As a result, the California survey has developed along independent and somewhat different lines from those followed elsewhere in the United States. This is perhaps to be expected since the National Survey is mainly concerned with wood as a product of the forest, whereas in California water transcends wood in importance.

For example, the inventory phase of the survey in the Douglas fir region has been primarily focused on lands either supporting or capable of supporting tree stands commercially valuable for lumber, pulp, and other wood products, because, with a superabundance of water, other types of wild land are of relatively minor importance. Thus the basic survey consists mainly of an estimate of the present timber stand and a map showing the various forest types and sites and their present condition. Both the estimates and the map were concurrently compiled from already existing information in the form of private and public timber cruises. Areas where data were non-existent were filled in by original field surveys. The type classification used was a scheme of so-called "volume types" somewhat similar to that already in use in the region by the Forest Service.

Contrast on the other hand the situation in California. In this State there is a scarcity of water and over large areas the most important product of wild lands is the yield of water. Forests imply not only tree stands but brush cover as well. In many localities the brush cover is often the more important of the two, as witness Los Angeles County, where they are spending over $500,000 annually in protecting their watersheds of which more than 90 percent are brush covered. A forest survey in California then, must of necessity apply with almost equal emphasis to both tree and lesser types of vegetation cover. A first consideration, therefore, was not a volume estimate of timber stands, although this is important, but rather a basic vegetation survey.

There have been three stages in the evolution of the California survey that is now in progress. The first is represented by a comparatively simple project which began in 1926. Its purpose was merely to provide data for a generalized vegetation map to be used in formulating statewide land use and fire protection policies. A more or less extensive survey was made under the supervision of the California Forest and Range Experiment Station in which many agencies and individuals participated. Lumber companies and other timber owners generously made their timber cruises available. Supervisors of various National Forests undertook to survey and compile the data for areas under their jurisdiction, as did also the Superintendents of the National Parks.

Substantial financial support was given by the Division of Forestry of the University of California. The State Forester's office, the Regional Forester of the U. S. Forest Service, and certain counties contributed both personnel and transportation facilities. The U. S. Geological Survey mapped broad vegetation types in connection with their topographic surveys. The Office of White Pine Blister Rust Control also mapped vegetation in conjunction with a "Ribes" reconnaissance of sugar pine areas.

Although superseded later by a more intensive project, this earlier survey has more than justified itself as shown by many important uses. The information so gathered concerning the forest and watershed lands of the state made possible a wiser allocation of Clarke-McNary cooperative fire protection funds and aided in obtaining additional federal allotments for this purpose. In fire control planning on the National Parks the data had an important part as well as in the preparation of a statewide park plan preparatory to an expenditure of some $12,000,000 of land purchases for state parks. Furthermore the project furnished much basic information not only for the Copeland report but also for the recent report on land planning of the President's Natural Resources Board. Not the least among its values was the experience gained, which was essential to the development of the technic of the survey as now conducted.

The second stage originated in response to an insistent demand in Southern California for a more intensive survey to supply data considered necessary for the proper evaluation and protection of watershed cover. A plan was evolved for mapping natural plant associations, at the same time obtaining plant size, density, and other pertinent data by means of sample plots. This was a conscious attempt to collect information basic in character for many purposes, so that the survey would be of value, not only for the obvious needs of the present but also for perhaps unforeseen developments of the future. The apparent values of this more comprehensive and thorough survey soon led to its adoption on a statewide basis. Some idea of its scope may be gained from the following presentation of the kind of data gathered.

1. A vegetation type map on a U. S. Geological Survey topographic quadrangle base, scale approximately 1 inch to 1 mile, showing broad plant associations, divided exclusive of herbaceous formations, into pure and mixed stands in which dominant species are indicated by symbols. Since in herbaceous formations subtypes are usually impossible to distinguish in mapping, dominant species are shown only where sample plots are taken and no attempt is made to delineate subtypes.

2. A supplementary map showing:

(a) Occurrence, by species, of individuals and small groups of trees in otherwise treeless types.

(b) Occurrence, by species, of scattered individuals or groups of ecologically important trees not abundant enough to be shown as dominant on the type map.

(c) Occurrence of shrub species of especial importance, the range of which would not be indicated by either the type map or the sample plots.

(d) Boundaries of comparatively recent burned-over areas that are visible on the ground.

3. Sample plots, referenced to the map, and representative of the various vegetation types; showing, among other things, species composition, size and stand density of trees and shrubs, and depth of leaf litter.

4. Herbarium for each quadrangle unit, containing specimens of all species shown on the map or sample plots.

5. Photographs representative of all types encountered and referenced to the map so that they may be repeated at a later time for the purpose of recording vegetational changes.

The third stage of the survey followed the authorization of the nation-wide forest survey by Federal statute and led directly to the fourth and final stage, that of obtaining the stand of timber in board and cubic feet. It bridges the gap between the vegetation map and this forest wood volume inventory by providing for the collection of additional data on lands capable of growing commercial tree crops. These data, shown by delineation and appropriate symbol, on transparent vellum superimposed on the base vegetation map, comprise the following:

1. A classification of timberland as virgin timber; second growth timber segregated into all-aged and even-aged stands; deforested areas, non-forest; and noncommercial rocky timber areas.

2. A site-index classification of all forest and potential forest land. (Site index, which in Forest Service studies in California is based on height attained by the average dominant in 300 years, is a measure of the productivity of the land for timber growing.)

3. A division of even-aged second-growth stands into 20-year age classes further subdivided as well, medium, and poorly stocked areas.

The final or timber estimate stage previously mentioned is still in the future. While a work plan for this part of the inventory has not yet been prepared the information obtained in the second and third stages now under way indicates the probable procedure. On cut-over areas supporting even-aged second-growth, site index, age-class, and degree of stocking are known; thus the timber estimate may easily be arrived at from yield tables. There remains, then, the virgin timber and selectively logged or all-aged second-growth stands. Where these are covered by comparatively recent and reliable cruises, probably checking and adjustment only are necessary. Elsewhere a simple line-plot sampling of the various types and sites, the area of which has already been mapped, is indicated. It would therefore seem that the problem of obtaining a timber estimate of California will be greatly simplified because of the present survey.

The foregoing outline of the development and character of the California project and its place in the scheme of the nation-wide survey leads to a consideration of its more important details. It has been shown that this California survey centers mainly in a natural vegetation map upon which is superimposed a further classification of the condition and productive capacity of timber-growing land. This latter classification needs no discussion here since it is essentially similar to that used in the survey of the Douglas fir region already described by Andrews.1/ Brief mention however will be made of

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1/ Andrews, H. J., 1932. The forest survey in the Douglas Fir Region, Journal of Forestry 30:267-275.

the site classification, since the method of collecting and recording the data exemplifies an inherent characteristic of the survey work; that is, collecting data, in so far as possible, in a manner that will give them a value beyond that of the immediate objective which in this case is a site map. As a basis for this map, the age and height of average dominant trees are measured. Such trees are carefully selected and their location referenced by number on the map. Age is determined by annual ring counts of cores extracted from them. These cores are labelled and, together with pertinent data recorded on the form provided for the purpose, are preserved for future use. Thus the data not only serve as a basis for mapping sites in the field but also are suitable for scientific study later.

The basic vegetation survey, as previously indicated, is not confined to forest land alone but embraces all of the natural vegetation of the state exclusive of that found in the deserts and in the larger valleys mainly devoted to agriculture. To date field work on more than 19 million acres out of a total of nearly 70 million acres has been completed.

The 15 and 30 minute topographic quadrangles of the U. S. Geological Survey on horizontal scales of approximately 1 inch and $\frac{1}{2}$ inch to the mile, respectively, are used both as base maps and control. Photostat enlargements of the 30 minute quadrangles to the inch scale are made so that base maps on a uniform scale are available for all field work. However the data when published will appear as an overprint on the original quadrangles and thus be on two scales. The vegetation types are mapped on these sheets by ocular observation and sketching from ridges, peaks, and other vantage points, supplemented by frequent sample plot checks. This is done by 2-man crews. Where a combination of automobile and foot travel is feasible, the crew leader usually maps while his assistant takes sample plots, measures trees, and extracts increment cores to determine site index, and collects herbarium specimens. But in more remote districts which must be covered on foot it is advantageous for each man to travel a separate route and not only map but gather the supplementary data as well. With average conditions it takes a crew from 6 to 8 weeks to complete the field work for a 15-minute quadrangle area of about 150,000 acres. For the vegetation map itself the field work is done at a cost of approximately 0.3 cents an acre; but in areas of forest or potential forest land where additional data are required the cost is about doubled.

In view of the complex vegetation conditions to be found in California, not only because of wide variations in climate but also because of disturbances resulting from human activities, it was necessary to develop a flexible scheme of type classification. It was also necessary, in order that this scheme be adapted to the ocular-observation-sketching method of mapping, that it be a classification of the dominant vegetation visible externally as from an airplane. Two concepts, (1) mosaic types and (2) pure and mixed stand subtypes, lend the essential flexibility. The first attempts to depict as accurately as possible complex vegetation conditions to be found naturally or as a result of fire or other disturbances, and the second, natural plant associations. A consideration of Table 1 will explain the application of these concepts to vegetation in general.

Table 1

Basis for classification of vegetation types in California

1 Herbs	2 Shrubs	3 Trees	4 Mosaics or Composites of 1,2,3
Marshland (Tidelands)	Sagebrush	Broadleaf (Hardwoods)	Shrub-Herb
Meadows (Wet Grassland)	Chaparral	Conifer (Softwoods)	Tree-Herb
Grass (Other Grassland)	Chaparral-Sagebrush	Conifer-Broadleaf	Tree-Shrub
			Tree-Shrub-Herb

In this scheme the dominant vegetation is considered under 4 categories: (1) Herbs, (2) Shrubs, (3) Trees and (4) Mosaics.

Herbs include all types where herbaceous vegetation forms approximately 80 percent or more of the dominant cover. This embraces marshlands, meadows and grassland where shrubby or tree growth forms less than 20 percent of the dominant cover.

Shrubs include:

(a) Sagebrush types where 80 percent or more of the dominant cover is formed by species of Salvia, Artemisia, Eriogonum, and other woody plants of like character.
(b) Chaparral types where 80 percent or more of the dominant cover consists of shrubs not sagebrush-like in their characteristics as, for example, shrubby Quercus species, Arctostaphylos and Ceanothus.
(c) Chaparral-Sagebrush where both chaparral and sagebrush shrubs are dominant but neither forms 80 percent or more of the dominant vegetation cover.

Under trees are designated:

(a) Broadleaf types where broadleaved trees occur in essentially pure stands, that is, form 80 percent or more of the dominant cover.
(b) Conifer types embracing essentially pure coniferous stands.
(c) Conifer-broadleaf types containing both conifers and broadleaf trees but with neither forming as much as 80 percent or more of the dominant cover.

Mosaic types include areas where the dominant vegetation is not purely herbaceous, shrubby, or arborescent but a composite of two or more of these formations, no one of which forms 80 percent or more of the cover. In these mosaics, as in other types, understory vegetation is not considered but only those elements of the vegetation cover visible from above as from an airplane.

As amplification of this general classification of vegetation, which is simply a division into pure and mixed major formations, by a further and similar segregation into pure and mixed stands by species completes the basic scheme of classification. A pure stand is defined as one in which a single species forms approximately 80 percent or more of the dominant cover; a mixed stand as one in which none of two or more species composing it occur to the extent of 80 percent. A pure stand is designated by the single important dominant. Ordinarily a mixed stand is designated by those dominants individually forming 20 percent or more of the cover. In mosaic formations, however, this percentage is applied to each class of vegetation separately. For example, in a tree-shrub formation are designated both the tree and shrub species forming 20 percent or more of the aggregate area occupied respectively by trees and shrubs. In shrub types the percent of cover formed by the various species is estimated directly on an area basis but in tree types it is frequently easier to approximate this by tree counts. These percents serve more accurately as guides for major types and for pure subtypes which stand out in more or less bold relief than for mixed stand subtypes. Where the latter merge from one subtype to another so gradually that there are no visible dividing lines the sample plots serve as a basis for a delineation which gives at least close altitude and slope exposure relationships.

It will be noted that this scheme does not set up any definite list of vegetation types for California but merely provides principles which enable the mapper to recognize and to portray graphically the various pure and mixed stand subtypes found on the ground. What the specific vegetation types are, can be finally stated only upon completion of the survey itself. However, the survey has progressed far enough so that it is possible to show in Table 2 the application of these principles to California vegetation.

Excluding items 1 to 3, this chart segregates the natural vegetation of California into 21 major types. These are differentiated on the map in color legend. Each represents an attempt to group together related subtypes with generally similar fire-hazard characteristics, and/or uses or qualities of economic importance. Thus the broad color divisions serve to make the maps the more readily usable by forest rangers, supervisors, engineers, and others charged with the management of wild lands, while the more detailed subtype delineation provides the basic information on vegetation desired by the research workers in forestry, ecology, and allied sciences.

Under the heading "shrub types" it will be noted that the chaparral or brushfield belt is divided into four types largely on the basis of fire hazard characteristics. The first, chamise chaparral, is distinguished by the dominance of Adenostoma fasciculatum. This shrub because of its fine needle-like leaves does not build up any appreciable ground litter, a fact which makes fires easier to control. In the second type or the chaparral proper, Adenostoma fasciculatum is nearly or entirely absent. In contrast with

Table 2

Major vegetation types of California[1]

	Herbaceous types	Shrub types	Woodland tree types	Commercial tree types	Sub-alpine tree types
Herbs	4. Marshland (Meadow 5. (Grassland				
Shrubs		6. Sagebrush 7. Chamiso chaparral 8. Chaparral 9. Somidesert chaparral 10. Timberland chaparral			
Trees			11. Woodland 12. (Pinon or (Juniper belt 13. Miscellaneous conifers	17. Redwood 18. Douglas fir belt 19. Pine belt 20. Spruce belt 21. Pine-fir belt 22. Fir belt	23. Lodgepole-white pine-belt 24. Whitebark-foxtail pine belt
Mosaics	(Herb-shrub mosaic shown as subtype of grassland)	(Shrub-herb mosaic shown as subtype of nearest related shrub type)	14. Woodland-grass 15. Woodland-sagebrush 16. Woodland-chaparral (Other mosaics as under commercial tree types)	(Conifer-herb or conifer-shrub mosaics shown as subtypes of nearest related tree types)	(Mosaics as under commercial tree types)

(1. (Barren
(Desert
2. Cultivated
3. Forest plantations)

1. Areas within any type of less than 50 percent cover are designated semibarren.

chamise chaparral it normally produces a deep litter, is of almost impenetrable density, and attains a greater height. The third chaparral type is designated semidesert chaparral because it normally clothes the mountain slopes bordering the desert. In species composition it is closely related to the chaparral type proper of adjacent areas but differs from it in being characteristically open instead of forming a dense uninterrupted cover. For this reason it presents a lower degree of fire hazard. These three chaparral associations are characteristic of the Upper Sonoran Life Zone,[2/] while the fourth, timberland chaparral, is characteristic of either the Transition or Canadian Life Zones. The latter has been called timberland chaparral because it is frequently a temporary type replacing fire-destroyed coniferous timber stands. Mosaics of chaparral with sagebrush species are not shown in separate color legend but as subtypes of the nearest related type.

The woodland tree types are characterized by either broadleaf or conifer species whose wood is used for little else than fuel. There are six major types, three of which are mosaics. Their definitions follow:

(1) The woodland type proper is primarily a broadleaf association which usually forms a closed canopy and which may or may not contain Digger pine.

(2) Pinon-Juniper comprises formations characterized by the dominance of either pinon, juniper, or both. Mosaics of these conifers with broadleaf trees, shrubs (except where mosaics of the shrub-like Juniperus californica and shrubs form a semidesert chaparral type), or grass are considered as subtypes and are therefore shown in the same color legend.

(3) Miscellaneous conifers embrace stands of such trees as Monterey pine, bigcone spruce, Coulter pine, knobcone pine, McNab cypress, and bristlecone fir, most of which are endemic to California. As in pinon-juniper formations, mosaics are shown as subtypes.

Woodland-grass, woodland-sagebrush and woodland-chaparral mosaics consist respectively of grassland, sagebrush, and chaparral areas, with more or less scattered individuals and small clumps of broadleaf trees with which the Digger pine may be associated. The woodland-grass type is primarily of grazing use and is one of the principal formations in the foothills of the Sierra Nevada and Coast Range Mountains. The woodland-sagebrush and woodland-chaparral in many cases apparently represent a deterioration of the woodland-grass type resulting from fires or overgrazing.

Commercial tree types are so designated because they are characterized by those conifers considered commercially valuable in California for such products as lumber and pulp. They are mainly characteristic of the Transition and Canadian Life Zones. Upon the basis of use and fire hazard characteristics a division into six belts is made. The first, or redwood belt, embraces those coniferous stands containing redwood as an important dominant, that is, more than 20 percent redwood by total number of dominant trees. The second, or

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2/ Hall, H. M. and J. Grinnell "Life Zones Indicators in California", Proc. Calif. Acad. Sci. 4th series, vol. 9, no. 2, pp. 37-67. 1919.

Douglas fir belt, comprises stands containing Douglas fir as an important dominant but not containing redwood or the commercial pines as important dominants. The third, or spruce belt consists of Sitka spruce, either in pure stands or in mixture with other conifers where neither redwood nor Douglas fir are also dominant. The fourth, or pine belt, includes coniferous stands in which one or more of the commercial pines are important dominants to the exclusion of true firs. The fifth, or pine-fir belt, is defined by the dominance of both commercial pines and true firs. The sixth, or fir belt, is distinguished by the dominance of true firs in the absence of commercial pines, redwood, Douglas fir, and those conifers distinguishing the sub-alpine tree types.

The sub-alpine tree types, as the name implies, are situated at higher altitudes. They embrace areas often possessing high scenic and recreational value but slight if any value for commercial growth of saw-timber or pulpwood. In those types growth is usually slow because of severe climatic conditions and trees are frequently scattered in occurrence, distorted in form, and relatively low in height. Two broad belts are recognized. The first, the lodgepole-white pine belt, occurs in the Canadian and Hudsonian Life Zones and is characterized by the dominance of lodgepole pine, western white pine, mountain hemlock, or weeping spruce to the exclusion of commercial pines, or species of the whitebark-foxtail pine belt. The second, or whitebark-foxtail pine belt, which is restricted to the Hudsonian Life Zone, is defined by the dominance of one or more of the following: whitebark pine, foxtail pine, limber pine, and bristlecone pine.

This completes the definitions of all the types shown in Table 2 that are not in themselves self-explanatory. This classification is not, however, complete without mention of the semibarren designation which is applied to areas within any type whose vegetation, while not so scanty as to cause the area to be classified as barren, yet covers less than half of the ground surface. Such conditions, which are usually found on rocky or steep, much eroded slopes are shown on the map by hatching.

Supplementing the vegetation type map based on the above classification there are sample plots taken not only as a check on the mapping but also to cross-section all types for details such as species composition, size, and stand density of trees and shrubs, and depth of leaf litter. For this sampling two forms were devised. The first was designed for shrubby or arborescent types and the second for herbaceous vegetation. In the former, the rectangle strip enclosing 100 squares corresponds to an area of 1/10 acre on the ground and the individual squares to milacres. The recorder paces along the center line of this strip and records for each square the species dominating it. At the same time, trees 4 inches and over in DBH within 33 feet of either side of this center line are tallied by species and diameter classes, thus affording a 2/10 acre sample of the tree stand.

Where less than 50 percent of any milacre square is covered by shrubby or herbaceous vegetation the character of the ground surface is indicated by appropriate symbols, as rock outcrop precluding vegetation, litter cover in which depth of litter and species origin is also indicated, or as simply openings lacking vegetation. The form also provides for recording the average height of each shrub species, as well as of the average dominant of each tree

species; and also, wherever possible, the average depth of litter formed by each shrub species. The second plot-form, used for sampling grassland and other herbaceous types, merely lists all species seen along a line 330 feet long. Plants are checked to show if abundant and whether occurring under shade, in the open, or both. On the reverse side, identical for both forms, provision is made for noting such additional information as slope exposure, percent of slope, soil character, and year of last burn. This second sample-plot form is substituted for the first in fairly recently burned-over shrub types where herbaceous vegetation is temporarily predominant. In such cases the headings "sprouts" and "seedlings" are respectively substituted for "open" and "shade" and the species are recorded accordingly, thus affording a more accurate picture of the fire succession type. In the woodland-grass type both forms are used at each sampling point and are given identical numbers.

Thus, by these methods, sampling is simply and rapidly done and there is a distinct advantage in being able, in shrubby and shrub-like vegetation, to express the relative importance of component species in percent of area covered. The plots are not mechanically located, but are selected as being representative of the type for that elevation and slope exposure. On each 15-minute quadrangle unit of approximately 150,000 acres an average of 75 plots are taken or about 1 to each 2000 acres. When the map is finally complete, there will be a total of some 35,000 samples which, either supplementing the map or in themselves, should prove of value in various studies of California vegetation.

As has been mentioned previously, the collection of herbarium specimens forms a part of the survey. The field instructions require that a specimen be collected from every species recorded upon the maps or in the sample plots of each quadrangle mapped. Moreover, in practice, a number of specimens are included with those demanded by the instructions. These usually consist of specimens of commonly occurring species or of plants of interest to the collector for one reason or another. Very complete field notes are included with each specimen, comprising, not only the customary information as to collector, date, elevation, location, etc., but also notes as to size and character of the plant, the slope exposure, the formation in which it grows, and the names of the more common associated species.

The primary purpose of the herbarium is to serve as a check upon field identifications and to afford a permanent record of the plants recorded from each quadrangle. However, it seems probable that its greatest value will eventually be found to lie in its wealth of material from all parts of the region, and the detailed information, as to the range, the habitat, and the associated plants, which will be available for each species. Eventually it is planned to include in the herbarium characteristic photographs of many of the plants together with such notes as may become available as to their ecology and their economic importance, for example, as grazing or browse plants, or for such purposes as erosion control.

Of what value is the mass of information so collected? Is the expense of a comprehensive survey of this kind warranted? These and similar questions frequently asked may be answered perhaps by an enumeration and discussion of the more important present and prospective uses of the data. However, since

form of publication, or the manner in which the data are to be made available to the public in general, has an important bearing on usefulness, this will be considered first.

Two sets of maps have been planned for publication, both showing data as an overprint on the U. S. Geological Survey topographic quadrangles. The first, the statewide vegetation type map, will embrace when complete a total of 220 sheets. These units are now being submitted progressively for publication and at an early date some 22 sheets will be available for distribution. They show, as has previously been explained in connection with the type classification, major types by color legend with a further delineation of subtypes in which species composition is indicated by symbols. Wide map margins provide necessary space, in addition to the customary legend, for a profile helpful in visualizing relation of types to elevation and slope exposure, an area table summarizing type areas by counties and national forests, and textual material descriptive of the type classification basis and the various types shown on the quadrangle.

The second set which has been tentatively termed "Economic Cover Maps" will not be statewide in scope as the vegetation maps, but will embrace 137 sheets or in other words only those quadrangles containing lands commercially important for growing timber stands. These maps will show by color legend five broad land classes: (1) forested, (2) watershed, (3) grazing, (4) cultivated, and (5) barren. Forested lands embrace all areas supporting commercial or sub-alpine tree types. Such lands are further segregated as (1) old-growth or virgin-timber, (2) young-growth, even-aged, and (3) young-growth, several or many-aged (usually selectively logged). Watershed and grazing lands, as the designation indicates, support a cover chiefly valuable for those purposes. The map also shows by hatching all lands, regardless of color designation, not suitable for growing commercial timber stands. All unhatched areas, embracing watershed and grazing lands as well as forested lands, are subdivided according to site index, or timber productive capacity. For even-aged young or second-growth stands, 20-year age classes and degree of stocking are indicated by a further delineation and appropriate symbol. Although compiled at the same time as the vegetation maps these so-called "Economic Cover" maps will be withheld from publication awaiting completion of the timber estimate, a phase of the survey not yet inaugurated. When published, the map margins will contain, in addition to textual material descriptive of the various classifications from an economic standpoint, a timber estimate summary by species as applied to the acreages of these classifications found within each county and national forest.

That these two maps, as yet not distributed will find multiple uses is apparent from the many requests for the data. Among those who have used or requested use of the data provided by the vegetation map may be listed engineers who are making appraisals of wild land; biologists engaged in wildlife habitat studies; agricultural economists wishing to locate cultivated lands in crop surveys; entomologists concerned with the control of such widely different insect pests as pine beetles and grasshoppers; botanists interested in the contribution of the survey in disclosing new species as well as extending the known ranges of many others; and county planning commissions seeking information in connection with land use and other planning.

In the U. S. Forest Service itself the data have found important uses. One of these was in connection with an extensive range survey of the San Joaquin Valley and adjoining foothills, an area approximating 10 million acres. Advance knowledge of the size, distribution, and character of the various vegetation types greatly aided in groundwork planning, reduced the amount of field work required, and thus enabled undertaking the field work of the project in one season which otherwise would not have been possible.

Another Forest Service project now in progress, that of fire-control planning for the four southern California national forests, is finding the vegetation type map of value. Among other things, this project is concerned with three factors, values at stake, hazard, and risk, each of which are sufficiently important to dominate fire-control plans in certain areas. The detailed information necessary for properly rating the second factor, hazard, is being provided by the vegetation type map.

Probably the single most important use to which the combined data contained in the two sets of maps have been put so far is in connection with a land utilization study of Eldorado County,3/ a cooperative project of the California Forest and Range Experiment Station of the U. S. Forest Service and the Giannini Foundation of the University of California. Since the results of this study have been published, it will suffice here to say that much of the basic data for the forestry and other aspects of this study as well as for a second study now under way embracing four additional counties were provided by the vegetation and economic cover maps.

In these land-use studies the value of the survey with its maps and sample plots is enhanced by the fact that it not only provides information about the present vegetation cover, but also discloses that, in many localities, the character of this cover is very different from that found by the first settlers. For example, from facts accumulated in the survey of western Eldorado County, the conclusion seemed warranted that, since the advent of the white man, the ponderosa pine belt has literally retreated up the Sierra slopes an average distance of 10 miles on a 30 mile front, leaving a deforested area of 162,000 acres, much of which has been invaded and occupied by tree and shrub species from nonforest areas below.

There are also values to be derived from a critical study of the data from an ecological standpoint. Obviously it is possible to present upon the published maps themselves only a fraction of the information accumulated. Therefore, in order to increase their utility and interest to the user, a further interpretation of the vegetation types in the light of an analysis of the supplementary sample plots and other data is planned. This will probably take the form of published regional studies which, upon the completion of the survey, will be combined into a comprehensive whole. The first of these will cover the southern California region as embraced by the six counties of Ventura,

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3/ Weeks, David, A. E. Wieslander, and C. L. Hill. The Utilization of Eldorado County Land. Giannini Foundation University of Calif. Bul. 572. 1934.

Los Angeles, San Bernardino, Riverside, Orange, and San Diego, for which the field survey has been completed and will soon be published. This study will attempt to correlate existing vegetation with various climatic and physical factors. In this connection the influence of man on the vegetation, with particular reference to the effect of fire, will be considered. The results to be expected from such a study might include the following, among others:

1. A partial explanation, at least, of the present distribution of vegetation types and dominant species.

2. A better understanding of type changes that have occurred in the past, those now in progress, or those to be expected to occur in the future.

3. Further contributions to our knowledge of the value of certain plants and types as indicators of particular soil and climatic conditions. These should have an important application in many fields, both in pure research and in such applied fields as game and land management.

4. Suggestions for future investigations and also a foundation for other or quantitative research.

Finally as indicated earlier, the California survey sets the stage, so to speak, for the volume inventory of the state's timber resources, and because of this survey the cost of the latter undertaking should be reduced materially.